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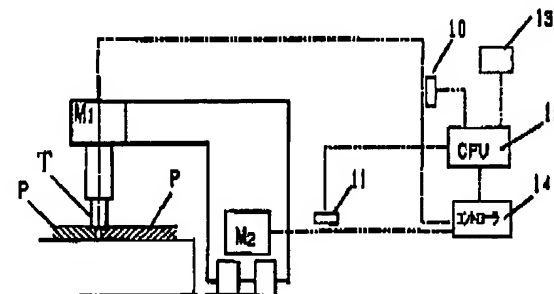
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(54) 【発明の名称】 摩擦撚拌接合における異常停止制御方法

(57) 【要約】 (修正有)

【課題】 摩擦撚拌接合工具が疲労破壊した瞬間に運転を停止して、工具の疲労破壊に伴って生じる不良接合部が可及的に小さくなるようにする。

【解決手段】 摩擦撚拌接合工具の回転駆動モータの電流値を基準値と比較し、電流値が基準値の 80% 以下になったときに、運転を停止（回転駆動モータ及び前進駆動モータの停止、または接合工具の引上げ、あるいは前進動作の停止など）することであり、他の解決手段は、摩擦撚拌接合工具の前進駆動モータの電流値を基準値と比較し、電流値が基準値の 80% 以下になったときに、運転を停止（前進駆動モータ及び前進駆動モータを停止）する。



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【特許請求の範囲】

【請求項1】摩擦攪拌接合工具の回転駆動モータ又は前進駆動モータの電流値の変化によって接合工具の破損を感知し、直ちに運転を停止するようにした摩擦攪拌接合における異常停止制御方法。

【請求項2】摩擦攪拌接合工具の回転駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止する摩擦攪拌接合における異常停止制御方法。

【請求項3】摩擦攪拌接合工具の前進駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止する摩擦攪拌接合における異常停止制御方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は摩擦攪拌接合における異常停止制御方法に関し、摩擦攪拌接合中に接合工具が破損したときに、これを瞬時に検知して運転を停止し、工具破損に伴う不良接合長さを可及的に短くして、接合継手の修復作業を迅速に行えるようにするものである。

【0002】

【従来の技術】アルミ金属板の接合方法として摩擦攪拌接合が用いられているが、鉄道車両の床板、側板などに使用されるアルミ型材等の接合継手の長さは極めて長い。他方、板材Pの摩擦攪拌接合は、図1、図2に示すように板材Pを支持板4上で突き合わせた状態で行われ、突合面が接合される一方で、接合部の表面が工具本体の下端面で深さ0.1mm(図2のL)程度削り取られた状態になる。接合工具Tは硬質金属部材であり、その先端に突設された比較的細いピン1が前進方向の強い抵抗を受けながら高速で回転するものである。ピン1の根元で比較的早期に疲労破壊することが避けられない。接合途中において工具Tが疲労破壊すると、接合がなされない状態で、接合部の表面だけが工具Tの本体2の型部3で削られてしまうことになる。接合途中で接合工具が疲労破壊すると、破損して後に工具Tが前進した部分は接合されない。この部分を再度接合する必要がある。このように再接合された接合部は不良接合部であり(表面が工具本体2の型部3で2回削られるなどが原因)、補修を要することになる。他方、1本の工具が疲労破壊するまでの接合長さは予測されるので、予測の範囲では工具を交換することで、接合中に工具が疲労破壊することが予め回避されるが、疲労強度の限度は個々の工具によってばらつきがあり、予測の接合長さに達する前に破損することもままある。接合中に工具が破損すると、作業者が駆動モーターの音の変化などを感知して速やかに運転を停止するが、それでもそれまでの間に工具は前進するので、接合不良部分がある程度の長さになることは避けられず、摩擦攪拌接合作業を自動化し、摩擦攪拌接合機械数台を一人の作業員で監視する場合など

は、このことが一層顕著になり、この接合不良部分を補修するのに多大の工数がかかる。

【0003】

【解決しようとする課題】この発明は、摩擦攪拌接合工具の破損に伴う上記問題を可及的に解消することを目的とするものであり、摩擦攪拌接合工具が疲労破壊した瞬間に運転を停止して、工具の疲労破壊に伴って生じる不良接合部が可及的に小さくなるように、異常停止制御方法を工夫することをその課題とするものである。

【0004】

【課題を解決するために講じた手段】上記課題解決のために講じた手段は、摩擦攪拌接合工具の回転駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止(回転駆動モータ及び前進駆動モータの停止、または接合工具の引上げ、あるいは前進動作の停止など)することであり、他の解決手段は、摩擦攪拌接合工具の前進駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止(前進駆動モータ及び前進駆動モータを停止)することである。

【0005】

【作用】摩擦攪拌接合工具は接合する板厚によってそのサイズが適宜選択され、当該工具の大きさによって回転駆動モータにかかる負荷はほぼ一定で、その平均駆動電流値はほぼ一定であって、正常な接合中の当該電流の変動幅は大きめに見ても±10%未満であるから、基準電流値(正常時の平均的な駆動電流値)の80%以下になったときは接合異常と見做される。接合中に接合工具のピンが疲労破壊した場合は、80%以下に瞬時に低下するから、80%以下になったときに運転を停止することによって、確実に、工具の疲労破壊と同時に運転が停止される。また、接合中は前進駆動モータの電流は2.3Aでほぼ一定であって、正常な接合中の当該電流の変動幅は大きめに見ても±10%未満であるから、基準電流の80%以下になったときは接合異常と見做される。接合中に接合工具のピンが疲労破壊した場合は、基準電流値の80%以下に瞬時に低下するから、基準電流値の80%以下になったときに運転を停止することによって、確実に、工具の疲労破壊と同時に運転が停止される。なお、上記基準電流値は接合する板の厚さに応じて予め設定してもよく、運転中の直近の平均電流値(例えば直近1秒間の平均値)であってもよい。また、接合開始時の回転モータ、前進駆動モータの電流値は小さいので、電流値が高から低に低下したことで、計測データが基準値の80%以下であることとのアンド条件で停止信号を発するようにすることで、接合中に「基準値の80%以下になったとき」だけ運転が停止されるようにすることができる。また、工具が疲労破壊したときの駆動電流値の減少率は、他の要因による場合に比して顕著であるから、基準電流値を設定してこれを計測データと比較

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するのに換えて、電流値の減少率を演算し、その減少率が設定した減少率よりも大きいときに停止信号を発するようにすることもできる。

【0006】

【実施の形態】次いで図面を参照して実施の形態を説明する。この実施の形態は、厚さ4.5mmのアルミ板を接合するものであり、接合工具のピン1の直径5mm、回転速度1750rpm、前進速度600mm/分で接合するものである。この実施の形態において長さ8mを摩擦攪拌接合する間の回転駆動モータ M_1 の平均電流値は11.4Aで、最大電流値は12.0A、最小電流値は11.0Aであり、他方、前進駆動モータ M_2 の平均電流値は2.3Aで、最大電流値は2.33A、最小電流値は2.28Aである（摩擦攪拌接合装置が違うと、これらの具体的な電流値は異なる）。回転駆動モータ M_1 の電流計測データをセンサー10からCPU12に伝送しており、また、前進駆動モータ M_2 の電流計測データをセンサー11からCPU12に伝送している。この実施の形態においては基準メモリ13に回転駆動モータの基準電流値11.4A、前進駆動モータの基準電流値2.3Aを設定してある。CPU12は0.5秒間隔でセンサー10、11の計測データを繰り返し呼出して、上記基準値と比較し、そのいずれかが基準値の80%を下回った時、コントローラ14に停止信号を発して、回転駆動モータ M_1 及び前進駆動モータ M_2 を同時に停止させるようにプログラムされている。2本の接合工具について試験を行った結果、1本目は接合長さ5mで破損し、その時の回転駆動電流は9.1Aまで低下し、前進駆動モータの電流値は1.8Aまで低下した。また、2本目は接合長さ4.5mで破損し、その時の回転駆動電流は9.0Aまで低下し、前進駆動モータの電流値は1.6Aまで低下した。いずれの場合も接合工具の破損と同時に電流値が基準値 $\times 0.8$ A（平均電流値の80%）以下に低下し、電流値が基準値以下に低下してから0.5秒以内に摩擦攪拌接合機の前進動作は停止する。この間の接合工具の前進距離は5mm以下である。したがって、工具のピンが疲労破壊するとほぼ同時に前進動作は停止され、工具破損に伴う不良接合部分の長さは、ほぼ工具の本体部分の半径相当に止まる。

【0007】

【発明の効果】以上述べたとおり、この発明は、接合工具の疲労破壊に伴って生じる音の変化、振動の変化などの様々な変化のうち、工具の回転駆動モータ、前進駆動モータの電流値の変化によって接合工具の疲労破壊を感知し、基準値と比較して基準値の80%以下になったとき、ただちに回転駆動モータ及び前進駆動モータを停止させるものであるから、ほとんどピンの破損と同時に運転が停止され、ピン破損してから工具の回転、前進動作が継続されることによる不良接合部の発生を完全にかつ確実に防止することができる。また、上記の音の変化や振動の変化などを感知して接合動作を停止する場合に比して、駆動電流の電流変化を検知するものであるから検知手段、制御システムを簡単にすることができる。また、接合する板の厚さ、または、接合工具のサイズによってその駆動電流は理論的にはほぼ一定であるが、接合条件の違いなど（接合面の隙間の変化、工具の押し付け力の変化など）によって駆動電流は若干の変動する。しかし、その平均値を基準値とし、その80%を数値値とすることによって、接合条件の違いなどによる平均駆動電流の定常変動を考慮することなく、確実に接合工具の疲労破壊を検知することができる。

【図面の簡単な説明】

【図1】は摩擦攪拌接合装置の斜視図である。

【図2】は図1のY-Y断面図である。

【図3】は実施の形態の模式図である。

【符号の説明】

P：アルミ板材

T：摩擦攪拌接合工具

1：摩擦攪拌接合工具のピン

2：摩擦攪拌接合工具の本体

3：摩擦攪拌接合工具の肩部

10：回転駆動電流のセンサー

11：前進駆動電流のセンサー

12：CPU

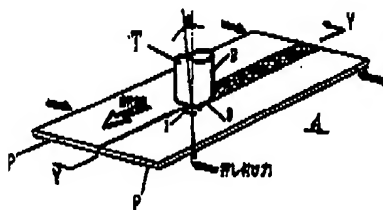
13：基準メモリ

14：コントローラ

M_1 ：回転駆動モータ

M_2 ：前進駆動モータ

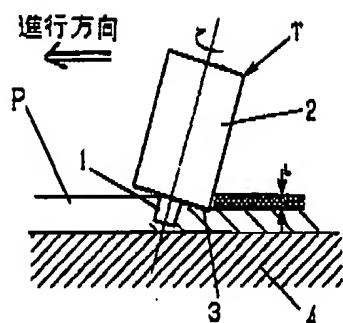
【図1】



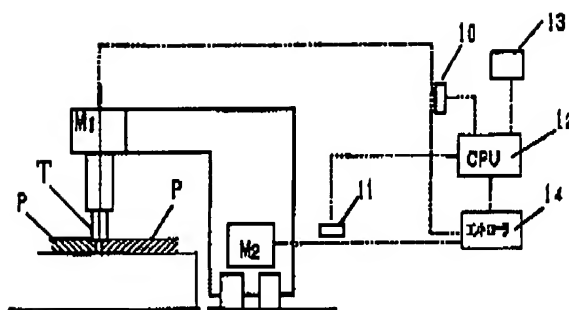
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【図2】



【図3】



【手続補正書】

【提出日】平成12年6月21日（2000.6.21）

1)

【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】全文

【補正方法】変更

【補正内容】

【書類名】明細書

【発明の名称】摩擦攪拌接合における異常停止制御方法

【特許請求の範囲】

【請求項1】 摩擦攪拌接合工具の回転駆動モータ又は前進駆動モータの電流値の変化によって接合工具の破損を感知し、直ちに運転を停止するようにした摩擦攪拌接合における異常停止制御方法。

【請求項2】 摩擦攪拌接合工具の回転駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止する摩擦攪拌接合における異常停止制御方法。

【請求項3】 摩擦攪拌接合工具の前進駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止する摩擦攪拌接合における異常停止制御方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 この発明は摩擦攪拌接合における異常停止制御方法に関し、摩擦攪拌接合中に接合工具が破損したときに、これを瞬時に検知して運転を停止し、工具破損に伴う不良接合長さを可及的に短くして、接合継手の修復作業を迅速に行えるようにするものである。

【0002】

【従来の技術】 アルミ金属板の接合方法として摩擦攪拌接合が用いられているが、鉄道車両の床板、側板などに使用されるアルミ型材等の接合継手の長さは極めて長

い。他方、板材Pの摩擦攪拌接合は、図1、図2に示すように板材Pを支持板4上で突き合わせた状態で行われ、突合面が接合される一方で、接合部の表面が工具本体の下端面で深さ0.1mm（図2のL）程度削り取られた状態になる。接合工具Tは硬質金属部材であり、その先端に突設された比較的細いピン1が前進方向の強い抵抗を受けながら高速で回転するものであるため、ピン1の根元で比較的早期に疲労破壊することが避けられない。接合途中において工具Tが疲労破壊すると、接合がなされない状態で、接合部の表面だけが工具Tの本体2の型部3で削られてしまうことになる。接合途中で接合工具が疲労破壊すると、破損して後に工具Tが前進した部分は接合されないため、この部分を再度接合する必要がある。他方、1本の工具が疲労破壊するまでの接合長さは予測されるので、予測の範囲では工具を交換することで、接合中に工具が疲労破壊することが予め回避されるが、疲労強度の限度は個々の工具によってばらつきがあり、予測の接合長さに達する前に破損することもある。接合中に工具が破損すると、作業者が駆動モータの音の変化などを感知して速やかに運転を停止するが、それでもそれまでの間に工具は前進するので、接合不良部分がある程度の長さになることは避けられず、摩擦攪拌接合作業を自動化し、摩擦攪拌接合機複数台を一人の作業員で監視する場合などは、このことが一層顕著になり、この接合不良部分を補修するのに多大の工数がかかる。

【0003】

【解決しようとする課題】 この発明は、摩擦攪拌接合工具の破損に伴う上記問題を可及的に解消することを目的とするものであり、摩擦攪拌接合工具が疲労破壊した瞬間に運転を停止して、工具の疲労破壊に伴って生じる不良接合部が可及的に小さくなるように、異常停止制御方法を工夫することをその課題とするものである。

【0004】

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【課題を解決するために講じた手段】上記課題解決のために講じた手段は、摩擦攪拌接合工具の回転駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止（回転駆動モータ及び前進駆動モータの停止、または接合工具の引上げ、あるいは前進動作の停止など）することであり、他の解決手段は、摩擦攪拌接合工具の前進駆動モータの電流値を基準値と比較し、電流値が基準値の80%以下になったときに、運転を停止（前進駆動モータ及び前進駆動モータを停止）することである。

【0005】

【作用】摩擦攪拌接合工具は接合する板厚によってそのサイズが適宜選択され、当該工具の大きさによって回転駆動モータにかかる負荷はほぼ一定で、その平均駆動電流値はほぼ一定であって、正常な接合中の当該電流の変動幅は大きめに見ても±10%未満であるから、基準電流値（正常時の平均的な駆動電流値）の80%以下になったときは接合異常と見做される。接合中に接合工具のピンが疲労破壊した場合は、80%以下に瞬時に低下するから、80%以下になったときに運転を停止することによって、確実に、工具の疲労破壊と同時に運転が停止される。また、接合中は前進駆動モータの電流は2.3Aでほぼ一定であって、正常な接合中の当該電流の変動幅は大きめに見ても±10%未満であるから、基準電流値の80%以下になったときは接合異常と見做される。接合中に接合工具のピンが疲労破壊した場合は、基準電流値の80%以下に瞬時に低下するから、基準電流値の80%以下になったときに運転を停止することによって、確実に、工具の疲労破壊と同時に運転が停止される。なお、上記基準電流値は接合する板の厚さに応じて予め設定してもよく、運転中の直近の平均電流値（例えば直近1秒間の平均値）であってもよい。また、接合開始時の回転モータ、前進駆動モータの電流値は小さいので、電流値が高から低に低下したことと、計測データが基準値の80%以下であることとのAND条件で停止信号を発するようにすることで、接合中において「基準値の80%以下になったとき」だけ運転が停止されるようにすることができる。また、工具が疲労破壊したときの駆動電流値の減少率は、他の要因による場合に比して顕著であるから、基準電流値を設定してこれを計測データと比較するのに換えて、電流値の減少率を演算し、その減少率が設定した減少率よりも大きいときに停止信号を発するようにすることもできる。

【0006】

【実施の形態】次いで図面を参照して実施の形態を説明する。この実施の形態は、厚さ4.5mmのアルミ板を接合するものであり、接合工具のピン1の直径5mm、回転速度1750rpm、前進速度600mm/分で接合するものである。この実施の形態において長さ8mmを摩擦攪拌接合する間の回転駆動モータM₁の平均電流値

は11.4Aで、最大電流値は12.0A、最小電流値は11.0Aであり、他方、前進駆動モータM₂の平均電流値は2.3Aで、最大電流値は2.33A、最小電流値は2.28Aである（摩擦攪拌接合装置が違うと、これらの具体的な電流値は異なる）。回転駆動モータM₁の電流計測データをセンサー10からCPU12に伝送しており、また、前進駆動モータM₂の電流計測データをセンサー11からCPU12に伝送している。この実施の形態においては基準メモリ13に回転駆動モータの基準電流値11.4A、前進駆動モータの基準電流値2.3Aを設定してある。CPU12は0.5秒間隔でセンサー10、11の計測データを繰り返し呼出して、上記基準値と比較し、そのいずれかが基準値の80%を下回った時、コントローラ14に停止信号を発して、回転駆動モータM₁及び前進駆動モータM₂を同時に停止させるようにプログラムされている。2本の接合工具について試験を行った結果、1本目は接合長さ5mmで破損し、その時の回転駆動電流は9.1Aまで低下し、前進駆動モータの電流値は1.8Aまで低下した。また、2本目は接合長さ4.5mmで破損し、その時の回転駆動電流は9.0Aまで低下し、前進駆動モータの電流値は1.6Aまで低下した。いずれの場合も接合工具の破損と同時に電流値が基準値×0.8A（平均電流値の80%）以下に低下し、電流値が基準値以下に低下してから0.5秒以内に摩擦攪拌接合機の前進動作は停止する。この間の接合工具の前進距離は5mm以下である。したがって、工具のピンが疲労破壊するとほぼ同時に前進動作は停止され、工具破損に伴う不良接合部分の長さは、ほぼ工具の本体部分の半径相当に止まる。

【0007】

【発明の効果】以上述べたとおり、この発明は、接合工具の疲労破壊に伴って生じる音の変化、振動の変化などの様々な変化のうち、工具の回転駆動モータ、前進駆動モータの電流値の変化によって接合工具の疲労破壊を感知し、基準値と比較して基準値の80%以下になったとき、ただちに回転駆動モータ及び前進駆動モータを停止させるものであるから、ほとんどピンの破損と同時に運転が停止され、ピン破損してから工具の回転、前進動作が継続されることによる不良接合部の発生を完全にかつ確実に防止することができる。また、上記の音の変化や振動の変化などを感知して接合動作を停止する場合に比して、駆動電流の電流変化を検知するものであるから検知手段、制御システムを簡単にすることができる。また、接合する板の厚さ、または、接合工具のサイズによってその駆動電流は理論的にはほぼ一定であるが、接合条件の違いなど（接合面の隙間の変化、工具の押し付け力の変化など）によって駆動電流は若干変動する。しかし、その平均値を基準値とし、その80%を敷居値とすることによって、接合条件の違いなどによる平均駆動電流の定常変動を考慮することなく、確実に接合工具の

(6)

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疲労破壊を検知することができる。

【図面の簡単な説明】

【図1】は摩擦撹拌接合装置の斜視図である。

【図2】は図1のY-Y断面図である。

【図3】は実施の形態の模式図である。

【符号の説明】

P：アルミ板材

T：摩擦撹拌接合工具

1：摩擦撹拌接合工具のピン

2：摩擦撹拌接合工具の本体

3：摩擦撹拌接合工具の肩部

10：回転駆動電流のセンサー

11：前進駆動電流のセンサー

12：CPU

13：基準メモリー

14：コントローラ

M₁：回転駆動モータ

M₂：前進駆動モータ

PATENT ABSTRACTS OF JAPAN

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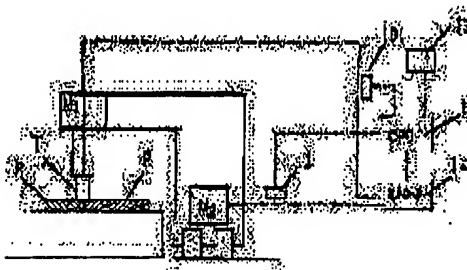
(71)Applicant : KAWASAKI HEAVY IND LTD

(22)Date of filing : 05.06.2000

(72)Inventor : YAMASHITA SEIICHIRO
HEIKO TAKEHIRO**(54) ABNORMALITY STOP CONTROLLING METHOD FOR FRICTION STIR CONNECTION****(57)Abstract:**

PROBLEM TO BE SOLVED: To provide an abnormality stop controlling method which stops operation soon after a friction stir connecting tool destructs in fatigue limit, and reduces defective joint portions generated with fatigue fracture of a tool as much as possible.

SOLUTION: One means for solution is that the current value of a rotational driving motor of the friction stir connecting tool is compared with a standard value, when the current value gets to below 80% of the standard value, operation is stopped (stopping rotational driving motor and forward driving motor, or pulling up a connecting tool, or stopping forward moving action), and another means for solution is that the current value of a forward driving motor of the friction stir connecting tool is compared with a standard value, when the current value gets to below 80% of the standard value, operation is stopped (stopping rotational driving motor and forward driving motor).

**LEGAL STATUS**

[Date of request for examination]

05.06.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

3290977

[Date of registration]

22.03.2002

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] The abnormal-stop control approach in the friction churning junction senses breakage of a junction tool and it was made to suspend operation immediately by the current value change of the rotation drive motor of a friction churning junction tool, or an advance drive motor.

[Claim 2] The abnormal-stop control approach in the friction churning junction which suspends operation when a current value turns into 80% or less of a reference value in the current value of the rotation drive motor of a friction churning junction tool as compared with a reference value.

[Claim 3] The abnormal-stop control approach in the friction churning junction which suspends operation when a current value turns into 80% or less of a reference value in the current value of the advance drive motor of a friction churning junction tool as compared with a reference value.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Industrial Application] When a junction tool is damaged during friction churning junction about the abnormal-stop control approach in friction churning junction, this is detected in an instant, operation is suspended, the defect junction die length accompanying tool breakage is shortened as much as possible, and it enables it for this invention to carry out restoration of a junction joint quickly.

[0002]

[Description of the Prior Art] Although friction churning junction is used as the junction approach of an aluminum metal plate, the die length of junction joints, such as aluminum mold material used for the floor plate of a rail car, a side plate, etc., is very long. On the other hand, while friction churning junction of Plate P is performed where Plate P is compared on a support plate 4 as shown in drawing 1 and drawing 2, and **** is joined, it will be shaved off by the front face of a joint depth a grade of 0.1mm (L of drawing 2) in respect of the lower limit of the body of a tool. Since the junction tool T rotates at high speed while the comparatively thin pin 1 which is a hard metal member and protruded at the tip receives strong resistance of the advance direction, carrying out fatigue breaking at an early stage comparatively at the root of a pin 1 is not avoided. When Tool T carries out fatigue breaking in the middle of junction, only the front face of a joint will be deleted in the mold section 3 of the body 2 of Tool T by the condition that junction is not made. It is in the middle of junction, and if a junction tool carries out fatigue breaking, since the part into which it damaged and Tool T moved forward behind will not be joined, it is necessary to join this part again. Thus, the re-joined joint is a defect joint (a front face results [being deleted twice in the form section 3 of the body 2 of a tool, etc. and]), and will require repair. on the other hand, the thing which it is exchanging tools and it is beforehand avoided in the range of prediction that a tool carries out fatigue breaking during junction since junction die length until one tool carries out fatigue breaking is predicted, but is damaged before dispersion's having the limit of fatigue strength by each tool and reaching the junction die length of prediction -- as -- it is . Although an operator will sense change of the sound of a drive motor etc. and operation will be promptly suspended if a tool is damaged during junction Since a tool still moves forward in between [till then], it is not avoided that a poor junction part becomes a certain amount of die length. When automating a friction churning junction activity and supervising friction churning splicing-machine two or more bases by one worker, this becomes much more remarkable and a great man day starts repairing this poor junction part.

[0003]

[Problem(s) to be Solved] This invention makes it that technical problem to devise the abnormal-stop control approach so that operation may be suspended the moment the friction churning junction tool carried out fatigue breaking of the above-mentioned problem accompanying breakage of a friction churning junction tool for the purpose of canceling as much as possible, and the defect joint produced in connection with fatigue breaking of a tool may become small as much as possible.

[0004]

[The means provided in order to solve a technical problem] When a current value turns into 80% or less of a reference value as compared with a reference value, the means provided for the above-mentioned technical-problem solution the current value of the rotation drive motor of a friction churning junction tool It is suspending operation (a halt of a rotation drive motor and an advance drive motor, a pull-up of a junction tool, or halt of advance actuation). Other solution means When a reference value is compared and a current value turns into 80% or less of a reference value in the current value of the advance drive motor of a friction churning junction tool, it is suspending operation (an advance drive motor and an advance drive motor being suspended).

[0005]

[Function] It is chosen suitably, and since it is less than **10% even if the average drive current value of the load concerning a rotation drive motor is about 1 law by about 1 law and the size looks at more greatly the range of fluctuation of the current concerned under normal junction with the magnitude of the tool concerned, when it becomes 80% or less of a reference current value (average drive current value of forward always), it is considered by the board thickness which joins a friction churning junction tool that it is the abnormalities in junction. When the pin of a junction tool carries out fatigue breaking during junction, since it falls to 80% or less in an instant, when it becomes 80% or less, operation is certainly suspended by fatigue breaking and coincidence of a tool by suspending operation. moreover, the current of an advance drive motor is about 1 law in 2.3A during junction, and since the range of fluctuation of the current concerned under normal junction is less than **10% even if it sees it more greatly, when it becomes 80% or less of reference current, it is considered that they are the abnormalities in junction. When the pin of a junction tool carries out fatigue breaking during junction, since it falls to 80% or less of a reference current value in an instant, when it becomes 80% or less of a reference current value, operation is certainly suspended by fatigue breaking and coincidence of a tool by suspending operation. In addition, the above-mentioned reference current value may be beforehand set up according to the thickness of the plate to join, and may be the latest average current value under operation (for example, average for [latest] 1 second). moreover, that the current value fell to low from quantity since the current value of the rotary motor at the time of junction initiation and an advance drive motor was small, and a thing [measurement data / 80% or less of a reference value] -- and it is emitting a stop signal on conditions, and during junction, "only when it becomes 80% or less of a reference value", operation can be suspended. Moreover, the percentage reduction of a drive current value when a tool carries out fatigue breaking is changed to setting up a reference current value as compared with the case where it is based on other factors, since it is remarkable, and comparing this with measurement data, calculates the percentage reduction of a current value, and when larger than the percentage reduction which the percentage reduction set up, it can emit a stop signal.

[0006]

[Embodiment of the Invention] Subsequently, the gestalt of operation is explained with reference to a drawing. The gestalt of this operation joins an aluminum plate with a thickness of 4.5mm, and joins it by part for diameter [of the pin 1 of a junction tool / of 5mm], rotational-speed 1750rpm, and advanced speed/of 600mm. The average current value of the rotation drive motor M1 while carrying out friction churning junction of die length of 8m in the gestalt of this operation is 11.4A, the maximum current value is 12.0A, the minimum current value is 11.0A, the average current value of another side and the advance drive motor M2 is 2.3A, the maximum current value is 2.33A and the minimum current value is 2.28A (when friction churning junction equipment is different, these concrete current values differ). The current measurement data of the rotation drive motor M1 are transmitted to CPU12 from the sensor 10, and the current measurement data of the advance drive motor M2 are transmitted to CPU12 from the sensor 11. In the gestalt of this operation, reference current value 11.4A of a rotation drive motor and reference current value 2.3A of an advance drive motor are set as the criteria memory 13. When the measurement data of sensors 10 and 11 are repeated and called at intervals of 0.5 seconds and the either is less than 80% of a reference value as compared with the above-mentioned reference value, CPU12 emits a stop signal for a controller 14, and is programmed to make

coincidence suspend the rotation drive motor M1 and the advance drive motor M2. As a result of examining about two junction tools, 1 Motome was damaged by junction die length of 5m, the rotation drive current at that time fell to 9.1A, and the current value of an advance drive motor fell to 1.8A. Moreover, 2 Motome was damaged by junction die length of 4.5m, the rotation drive current at that time fell to 9.0A, and the current value of an advance drive motor fell to 1.8A. In any case, advance actuation of a friction churning splicing machine is suspended within 0.5 seconds after a current value falls to breakage and coincidence of a junction tool below at reference-value $\times 0.8A$ (80% of an average current value) and a current value falls below to a reference value. The advance distance of a junction tool in the meantime is 5mm or less. Therefore, if the pin of a tool carries out fatigue breaking, advance actuation will be mostly suspended by coincidence, and the die length for the defect joint accompanying tool breakage stops at an equivalent for the radius of the body part of a tool mostly.

[0007]

[Effect of the Invention] Change of the sound which produces this invention in connection with fatigue breaking of a junction tool as stated above. When fatigue breaking of a junction tool is sensed and it becomes 80% or less of a reference value among various change of change of vibration etc. as compared with a reference value by the current value change of the rotation drive motor of a tool, and an advance drive motor, Since a rotation drive motor and an advance drive motor are stopped immediately, operation is almost suspended by breakage and coincidence of a pin, and after carrying out pin breakage, rotation of a tool and generating of the defect joint by advance actuation being continued can be prevented completely certainly. Moreover, as compared with the case where sense change of the above-mentioned sound, change of vibration, etc., and junction actuation is suspended, since current change of a drive current is detected, a detection means and a control system can be simplified. moreover — although the drive current is about 1 law theoretically by the thickness of the plate to join, or the size of a junction tool — the differences among junction conditions (change of the clearance between planes of composition, change of the pressure of a tool, etc.) etc. — a drive current — some — changing. However, fatigue breaking of a junction tool can be detected certainly, without taking into consideration stationary fluctuation of the average drive current by ** of junction conditions which it is different and is not by making the average into a reference value and making the 80% into a threshold value.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the perspective view of **** churning junction equipment.

[Drawing 2] It is the Y-Y sectional view of ****1 .

[Drawing 3] It is the mimetic diagram of the gestalt of ****.

[Description of Notations]

P: Aluminum plate

T: Friction churning junction tool

1: The pin of a friction churning junction tool

2: The body of a friction churning junction tool

3: The shoulder of a friction churning junction tool

10: The sensor of a rotation drive current

11: The sensor of an advance drive current

12:CPU

13: Criteria memory

14: Controller

M1: Rotation drive motor

M2: Advance drive motor

[Translation done.]

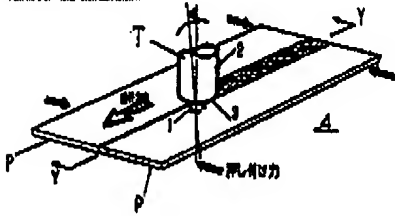
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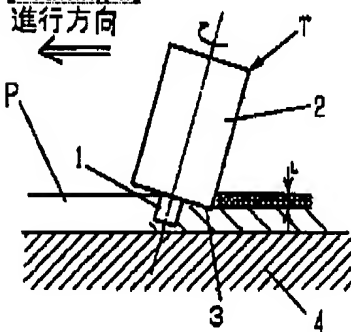
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DRAWINGS

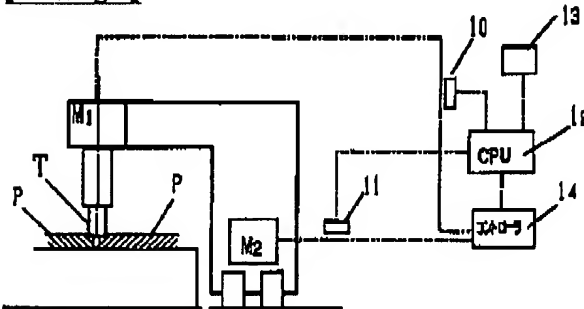
[Drawing 1]



[Drawing 2]



[Drawing 3]



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WRITTEN AMENDMENT

----- [a procedure revision]

[Filing Date] June 21, Heisei 12 (2000. 6.21)

[Procedure amendment 1]

[Document to be Amended] Specification

[Item(s) to be Amended] Whole sentence

[Method of Amendment] Modification

[Proposed Amendment]

[Document Name] Specification

[Title of the Invention] The abnormal-stop control approach in friction churning junction

[Claim(s)]

[Claim 1] The abnormal-stop control approach in the friction churning junction senses breakage of a junction tool and it was made to suspend operation immediately by the current value change of the rotation drive motor of a friction churning junction tool, or an advance drive motor.

[Claim 2] The abnormal-stop control approach in the friction churning junction which suspends operation when a current value turns into 80% or less of a reference value in the current value of the rotation drive motor of a friction churning junction tool as compared with a reference value.

[Claim 3] The abnormal-stop control approach in the friction churning junction which suspends operation when a current value turns into 80% or less of a reference value in the current value of the advance drive motor of a friction churning junction tool as compared with a reference value.

[Detailed Description of the Invention]

[0001]

[Industrial Application] When a junction tool is damaged during friction churning junction about the abnormal-stop control approach in friction churning junction, this is detected in an instant, operation is suspended, the defect junction die length accompanying tool breakage is shortened as much as possible, and it enables it for this invention to carry out restoration of a junction joint quickly.

[0002]

[Description of the Prior Art] Although friction churning junction is used as the junction approach of an aluminum metal plate, the die length of junction joints, such as aluminum mold material used for the floor plate of a rail car, a side plate, etc., is very long. On the other hand, while friction churning junction of Plate P is performed where Plate P is compared on a support plate 4 as shown in drawing 1 and drawing 2, and ***** is joined, it will be shaved off by the front face of a joint depth a grade of 0.1mm (L of drawing 2) in respect of the lower limit of the body of a tool. Since the junction tool T rotates at high speed while the comparatively thin pin 1 which is a hard metal member and protruded at the tip receives strong resistance of the advance direction, carrying out fatigue breaking at an early stage comparatively at the root of a pin 1 is not avoided. When Tool T carries out fatigue breaking in the middle of junction, only the front face of a joint will be deleted in the mold section 3 of the body 2 of Tool T by the condition that junction is not made. It is in the middle of junction, and if a junction tool carries out fatigue breaking, since the part into which it damaged and Tool T moved forward behind will not be

joined, it is necessary to join this part again. on the other hand, the thing which it is exchanging tools and it is beforehand avoided in the range of prediction that a tool carries out fatigue breaking during junction since junction die length until one tool carries out fatigue breaking is predicted, but is damaged before dispersion's having the limit of fatigue strength by each tool and reaching the junction die length of prediction — as — it is . Although an operator will sense change of the sound of a drive motor etc. and operation will be promptly suspended if a tool is damaged during junction Since a tool still moves forward in between [till then], it is not avoided that a poor junction part becomes a certain amount of die length. When automating a friction churning junction activity and supervising friction churning splicing-machine two or more bases by one worker, this becomes much more remarkable and a great man day starts repairing this poor junction part.

[0003]

[Problem(s) to be Solved] This invention makes it that technical problem to devise the abnormal-stop control approach so that operation may be suspended the moment the friction churning junction tool carried out fatigue breaking of the above-mentioned problem accompanying breakage of a friction churning junction tool for the purpose of canceling as much as possible, and the defect joint produced in connection with fatigue breaking of a tool may become small as much as possible.

[0004]

[The means provided in order to solve a technical problem] When a current value turns into 80% or less of a reference value as compared with a reference value, the means provided for the above-mentioned technical-problem solution the current value of the rotation drive motor of a friction churning junction tool It is suspending operation (a halt of a rotation drive motor and an advance drive motor, a pull-up of a junction tool, or halt of advance actuation). Other solution means When a reference value is compared and a current value turns into 80% or less of a reference value in the current value of the advance drive motor of a friction churning junction tool, it is suspending operation (an advance drive motor and an advance drive motor being suspended).

[0005]

[Function] it is chosen suitably, and since it is less than **10% even if the average drive current value of the load concerning a rotation drive motor is about 1 law by about 1 law and the size looks at more greatly the range of fluctuation of the current concerned under normal junction with the magnitude of the tool concerned, when it becomes 80% or less of a reference current value (average drive current value of forward always), it is considered by the board thickness which joins a friction churning junction tool that it is the abnormalities in junction. When the pin of a junction tool carries out fatigue breaking during junction, since it falls to 80% or less in an instant, when it becomes 80% or less, operation is certainly suspended by fatigue breaking and coincidence of a tool by suspending operation. moreover, the current of an advance drive motor is about 1 law in 2.3A during junction, and since the range of fluctuation of the current concerned under normal junction is less than **10% even if it sees it more greatly, when it becomes 80% or less of reference current, it is considered that they are the abnormalities in junction. When the pin of a junction tool carries out fatigue breaking during junction, since it falls to 80% or less of a reference current value in an instant, when it becomes 80% or less of a reference current value, operation is certainly suspended by fatigue breaking and coincidence of a tool by suspending operation. In addition, the above-mentioned reference current value may be beforehand set up according to the thickness of the plate to join, and may be the latest average current value under operation (for example, average for [latest] 1 second). moreover, that the current value fell to low from quantity since the current value of the rotary motor at the time of junction initiation and an advance drive motor was small, and a thing [measurement data / 80% or less of a reference value] — and it is emitting a stop signal on conditions, and during junction, "only when it becomes 80% or less of a reference value", operation can be suspended. Moreover, the percentage reduction of a drive current value when a tool carries out fatigue breaking is changed to setting up a reference current value as compared with the case where it is based on other factors, since it is remarkable, and comparing this with measurement data.

calculates the percentage reduction of a current value, and when larger than the percentage reduction which the percentage reduction set up, it can emit a stop signal.

[0006]

[Embodiment of the Invention] Subsequently, the gestalt of operation is explained with reference to a drawing. The gestalt of this operation joins an aluminum plate with a thickness of 4.5mm, and joins it by part for diameter [of the pin 1 of a junction tool / of 5mm], rotational-speed 1750rpm, and advanced speed/of 600mm. The average current value of the rotation drive motor M1 while carrying out friction churning junction of die length of 8m in the gestalt of this operation is 11.4A, the maximum current value is 12.0A, the minimum current value is 11.0A, the average current value of another side and the advance drive motor M2 is 2.3A, the maximum current value is 2.33A and the minimum current value is 2.28A (when friction churning junction equipment is different, these concrete current values differ). The current measurement data of the rotation drive motor M1 are transmitted to CPU12 from the sensor 10, and the current measurement data of the advance drive motor M2 are transmitted to CPU12 from the sensor 11. In the gestalt of this operation, reference current value 11.4A of a rotation drive motor and reference current value 2.3A of an advance drive motor are set as the criteria memory 13. When the measurement data of sensors 10 and 11 are repeated and called at intervals of 0.5 seconds and the either is less than 80% of a reference value as compared with the above-mentioned reference value, CPU12 emits a stop signal for a controller 14, and is programmed to make coincidence suspend the rotation drive motor M1 and the advance drive motor M2. As a result of examining about two junction tools, 1 Motome was damaged by junction die length of 5m, the rotation drive current at that time fell to 9.1A, and the current value of an advance drive motor fell to 1.8A. Moreover, 2 Motome was damaged by junction die length of 4.5m, the rotation drive current at that time fell to 9.0A, and the current value of an advance drive motor fell to 1.6A. In any case, advance actuation of a friction churning splicing machine is suspended within 0.5 seconds after a current value falls to breakage and coincidence of a junction tool below at reference-value $\times 0.8A$ (80% of an average current value) and a current value falls below to a reference value. The advance distance of a junction tool in the meantime is 5mm or less. Therefore, if the pin of a tool carries out fatigue breaking, advance actuation will be mostly suspended by coincidence, and the die length for the defect joint accompanying tool breakage stops at an equivalent for the radius of the body part of a tool mostly.

[0007]

[Effect of the Invention] Change of the sound which produces this invention in connection with fatigue breaking of a junction tool as stated above, When fatigue breaking of a junction tool is sensed and it becomes 80% or less of a reference value among various change of change of vibration etc. as compared with a reference value by the current value change of the rotation drive motor of a tool, and an advance drive motor, Since a rotation drive motor and an advance drive motor are stopped immediately, operation is almost suspended by breakage and coincidence of a pin, and after carrying out pin breakage, rotation of a tool and generating of the defect joint by advance actuation being continued can be prevented completely certainly. Moreover, as compared with the case where sense change of the above-mentioned sound, change of vibration, etc., and junction actuation is suspended, since current change of a drive current is detected, a detection means and a control system can be simplified. Moreover, although the drive current is almost fixed theoretically by the thickness of the plate to join, or the size of a junction tool, as for a drive current, it changes a little by the difference among junction conditions etc. (change of the clearance between planes of composition, change of the pressure of a tool, etc.). However, fatigue breaking of a junction tool can be detected certainly, without taking into consideration stationary fluctuation of the average drive current by ** of junction conditions which it is different and is not by making the average into a reference value and making the 80% into a threshold value.

[Brief Description of the Drawings]

[Drawing 1] It is the perspective view of ***** churning junction equipment.

[Drawing 2] It is the Y-Y sectional view of *****1.

[Drawing 3] It is the mimetic diagram of the gestalt of *****.

[Description of Notations]**P:** Aluminum plate**T:** Friction churning junction tool**1:** The pin of a friction churning junction tool**2:** The body of a friction churning junction tool**3:** The shoulder of a friction churning junction tool**10:** The sensor of a rotation drive current**11:** The sensor of an advance drive current**12:** CPU**13:** Criteria memory**14:** Controller**M1:** Rotation drive motor**M2:** Advance drive motor

[Translation done.]

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